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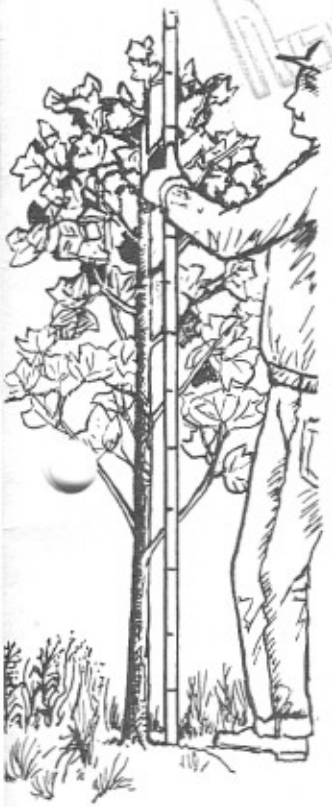
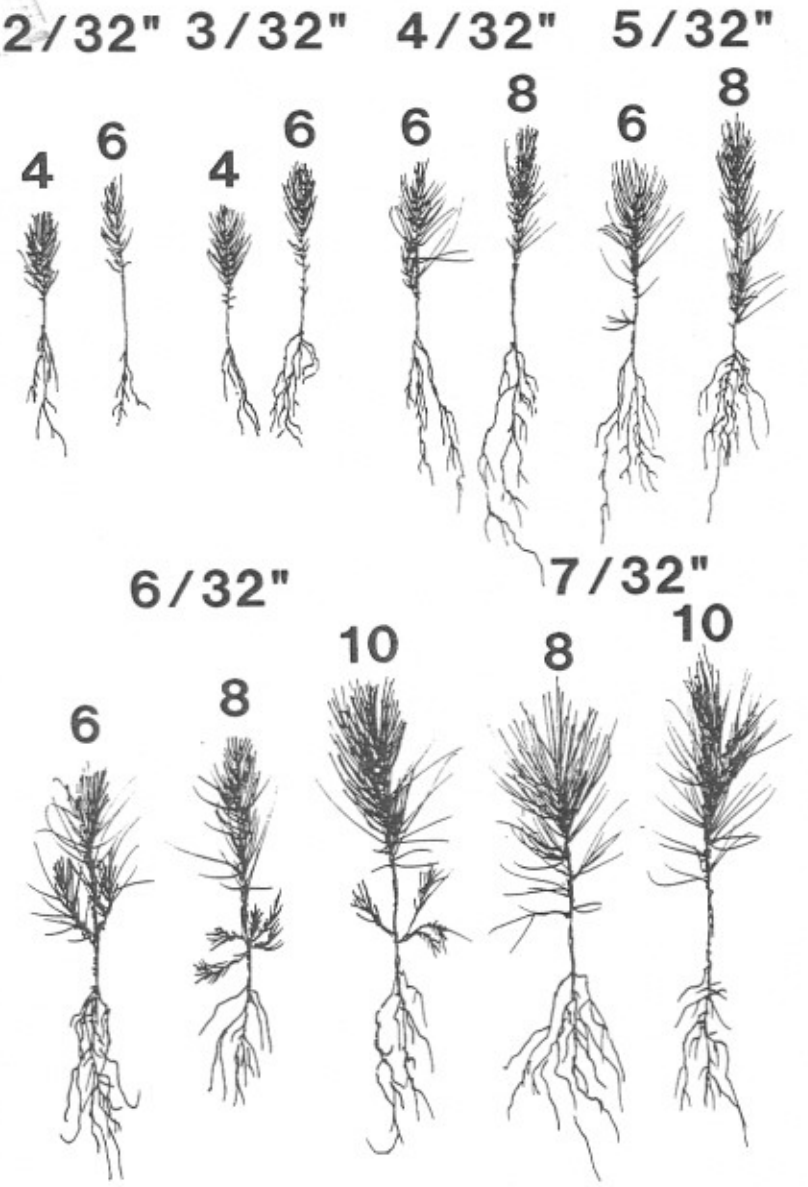
25 & 26 YEAR MEASUREMENT OF LOBLOLLY PINE SEEDLING GRADE STUDY





Virginia
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Age 26 and 25 Measurement of Loblolly Seedling Grade Studies Installed in 1966 And 1967

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Abstract

Seedlings were separated by root collar diameter, top length, and presence of a terminal bud, in 1966 and 1967. They were assigned to four separate studies that were similar in each year. Spacing was 3 X 3 feet. Results for survival and height growth at age three were published in 1973.

Total height and DBH of each surviving seedling was measured at age 26 (1966 study) and 25 (1967 study). Survival was only 27 and 31 percent as a result of the close spacing.

At age three, seedlings in the 5/32 and 6/32-inch classes averaged about a foot taller than seedlings in the 2/32 and 3/32-inch classes. They also were considerably stouter and had considerably more foliage. At ages 26 and 25, the differences had reversed, and seedlings in the 2/32 and 3/32-inch classes were about a foot taller than the 5/32 and 6/32-inch classes. Small seedlings were also as large or larger in DBH.

Introduction

Similar loblolly pine seedling grade studies were installed in 1966 and 1967, and survival and height at age three were published in Occasional Report No. 40, April 1973. Seedlings were separated by root collar diameter, top length, and presence or absence of a well-developed terminal bud.

The seedlings were lifted, measured, and separated into diameter, top length, and bud classes during March 7 to 10 in 1966 and March 8 to 13 in 1967. Seedlings were carefully hand-lifted from 18 different beds in 1966 and 30 beds in 1967.

The seedlings obtained from these separations were divided into four small, factorial studies in each year. Each of the four small studies was replicated three times in randomized blocks, using row plots of 20 seedlings each. The three replications of the four separate studies were randomly assigned to three larger blocks, so that each larger block contained one replication of each of the four separate studies.

The 1966 seedlings were divided into four separate studies, as follows:

1. 2/32 and 3/32-inch stem diameters with 4 and 6-inch tops, with no buds.

2. 3/32 and 4/32-inch stem diameters with 4 and 6-inch tops, with and without buds.

3. 4/32, 5/32, and 6/32-inch stem diameters with 6 and 8-inch tops, with and without buds.

4. 6/32 and 7/32-inch seedlings with 8 and 10-inch tops, with and without buds.

The 1967 seedlings were divided into four separate studies, as follows:[1]

1. 2/32 and 3/32-inch stem diameters with 4 and 6-inch tops, with no buds.

2. 3/32 and 4/32-inch stem diameters with 6 and 8-inch tops, with and without buds.

3. 4/32 and 5/32-inch stem diameters with 6, 8, and 10-inch tops, with and without buds.

4. 5/32 and 6/32-inch stem diameters with 8 and 10-inch tops, with and without buds.

Seedlings were planted at a spacing of 3 feet by 3 feet, with a 9-foot buffer between the four separate studies in each block. When measuring and separating seedlings into classes, we always had classes (diameter-length-bud combinations) for which we did not have enough seedlings for three 20-seedling rows. We planted what we had anyway, as extra rows adjacent to the separate, factorial studies. For example, in Experiment 1 in 1966, we had enough 2/32-inch seedlings that had set buds for just two 20-seedling rows. We planted both of these in Block 1, on one side of the four-row factorial study. The 9-foot buffer was then between one of these extra rows and the adjacent study.

Survival at age three in relation to initial root collar diameter was similar in 1966 and 1967 (Figure 1). Survival was best for 4, 5, and 6/32-inch seedlings, only 2 to 3 percentage points lower for 2 and 3/32-inch seedlings, and 10 to 15 percentage points lower for 7/32-inch seedlings. Seedlings were planted in mid-March in both years, which is the safest time to plant seedlings in Virginia. Had the seedlings been planted in December or January, the survival of 2 and 3/32-inch seedlings would probably have been considerably lower than the survival of 4, 5, and 6/32-inch seedlings.

At age three, seedling height was related to initial root collar diameter, with 5, 6, and 7/32-inch seedlings the tallest and similar in height, and 2 and 3/32-inch seedlings the shortest (Figure 2). The difference between the smallest and largest-diameter seedlings was a little over one foot in 1966, and a little less than one foot in 1967. However, the height difference of only one foot does not fairly represent the difference in appearance between small and large diameter seedlings; the larger diameter seedlings were noticeably stouter at age three, and had considerably more foliage (Figures 3, 4, and 5).

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[1]A total of seventy-five 7/32-inch seedlings, which had top lengths of 8, 10, and 12 inches, were graded. These were pooled to provide enough seedlings for three 20-seedling rows and 3 partial rows of 5 seedlings each.

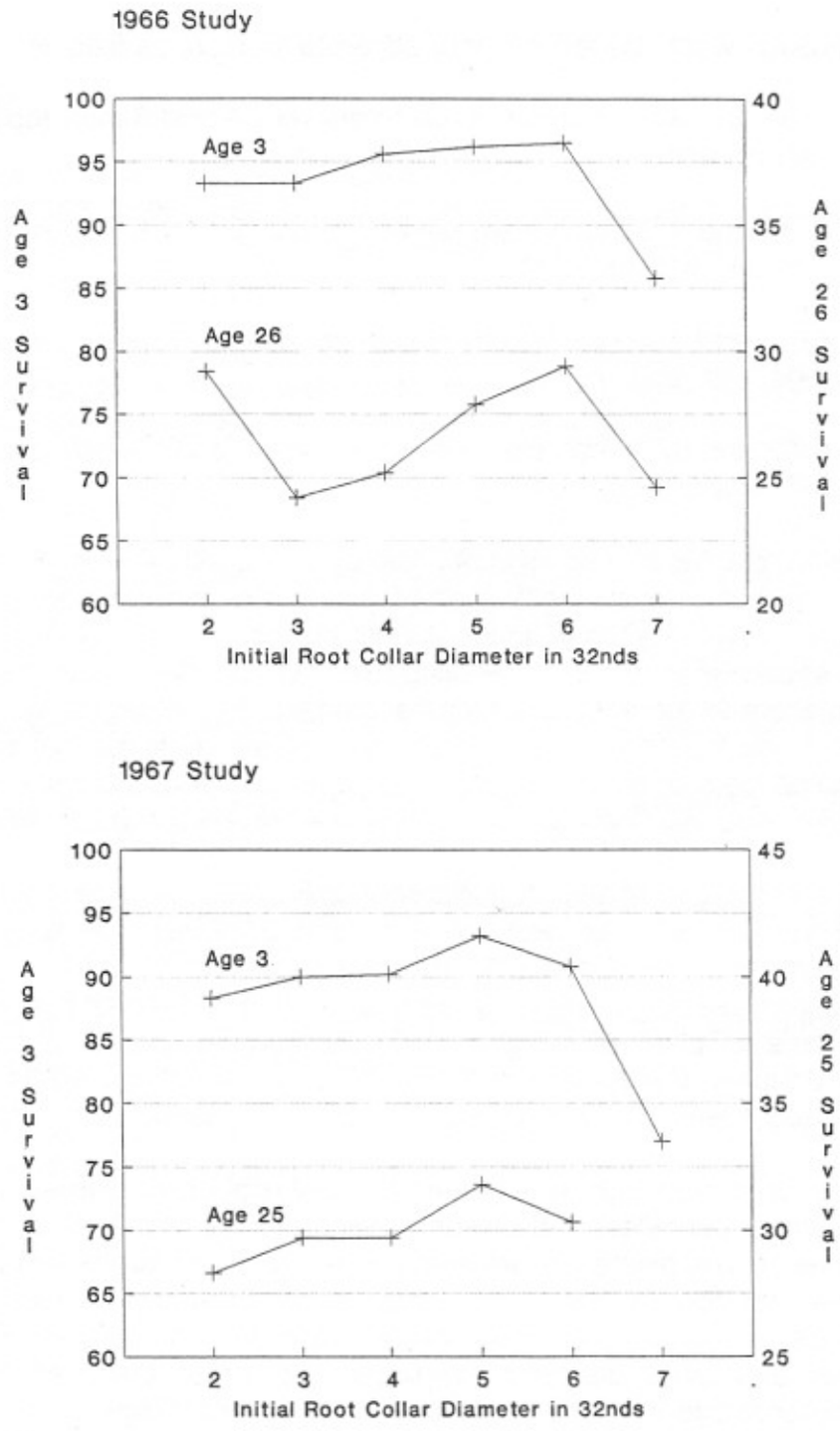

Figure 1. **Relationship between survival and initial root collar diameter at ages 3 and 26 or 25 (top length and bud classes combined).**

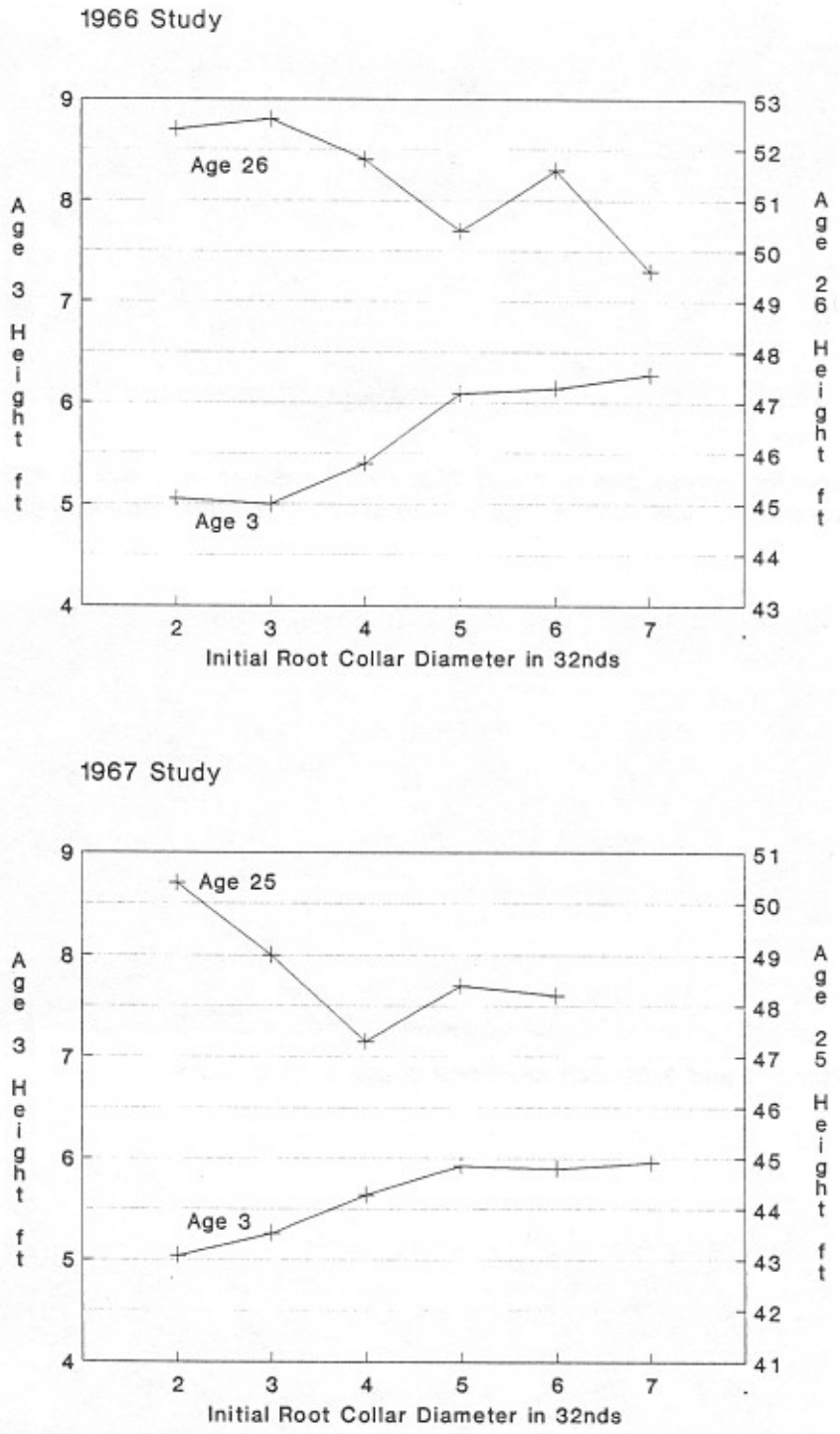

Figure 2. **Relationship between height (in feet) and initial root collar diameter at ages 3 and 26 or 25 (top length and bud classes combined).**

Figure 3. Looking across plot of 2 and 3/32 inch seedlings to a plot of 4, 5, and 6/32 inch seedlings; 1966 study at age 2 (man standing in buffer between plots).

Figure 4. Plot of 2 and 3/32 inch seedlings at age 3, 1966 study.

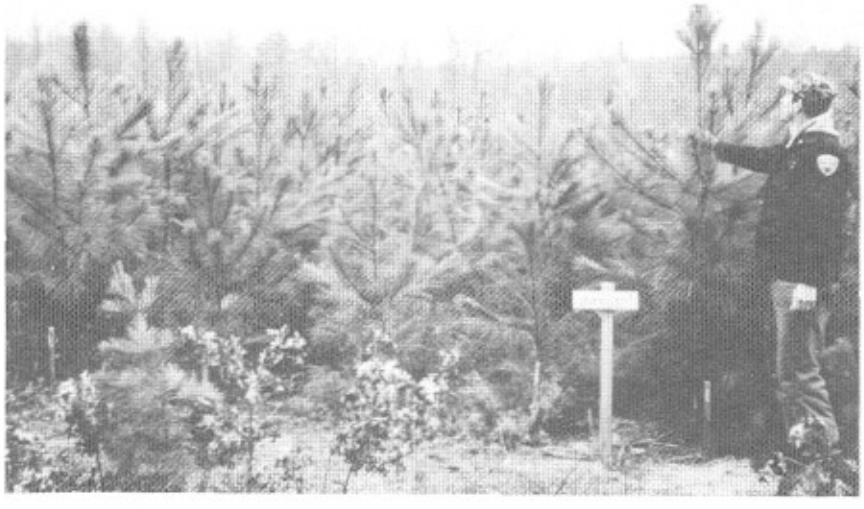

Figure 5. Plot of 4, 5, and 6/32 inch seedlings at age 3, 1966 study.

Top length differences, and presence of a terminal bud, had only minor and inconsistent effects on survival and height growth.

Measurement at Age 26 and 25

These plots were still in remarkably good shape in the spring of 1992 with no signs of catastrophic mortality due to ice, wind, bark beetles, etc. Mortality had been heavy, as one would expect, but it all seemed to be competition induced. We measured DBH to the nearest inch, and total height to the nearest foot on all surviving trees, noting which trees were dominant or co-dominant.

Results and Discussion

Appendix 1 and 2 present survival, mean height, mean DBH, and basal area per acre at age 26 (1966) and 25 (1967) for the three replications (rows) of each treatment of each of the four separate studies. Basal areas for individual rows in these tables are extremely variable, ranging from 11 to 441 square feet per acre. A 20-seedling row at a 3 by 3 foot spacing (with a 10 to 12-foot buffer on the ends of the row) occupies less than 1/200 acre. We calculated overall basal area, using the total area, including buffers, for all three blocks in each year, to be 199.3 and 185.2 square feet per acre for 1966 and 1967, respectively.

Overall survival was only 27 and 31 percent at age 26 and 25 in the 1966 and 1967 studies, respectively. The survival trends present at age three, with respect to initial root collar diameter, were still present (Figure 1).[2]

Height growth trends, however, had changed in an unexpected and surprising manner. The smallest diameter classes, which had been the shortest at age three, were the tallest at age 26 and 25 (Figure 2).[2]

When these studies were installed, we were only interested in seedling survival and height growth for three years, and did not anticipate measuring after 25 or 26 years. A 3-foot spacing between seedlings, with a 9-foot space between sub-blocks, was satisfactory for three years, but the 9-foot buffer between sub-blocks presented serious problems by age 25 or 26. Outside seedling rows, adjacent to these 9-foot buffers, survived and grew in diameter considerably better than interior rows with a 3-foot space on both sides. Height growth was also favored in outside rows, because more of the trees in these rows were able to maintain a co-dominant or dominant crown position.

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[2]*Survival and height of 7/32 inch seedlings at age 25 for the 1967 study are not presented because they were planted by themselves and all rows were "outside" rows (see discussion of outside rows in paragraph following).*

In Table 1, all root collar diameter, top length, and bud classes have been averaged for survival, height, and DBH for interior and outside rows.

Table 1. Average survival, height, and DBH at age 26 or 25 for interior and outside rows.

	Survival		Height		DBH	
	Interior	Outside	Interior	Outside	Interior	Outside
1966	23.6	37.1	50.3	54.0	5.51	6.94
1967	29.2	37.9	47.8	51.2	5.33	6.46

There were 21 outside rows in 1966 and 12 in 1967 out of a total of 96 rows in each year. In Table 2, means for inside and outside rows separately and combined are presented by initial diameter class for survival, height, DBH, and basal area at age 26 and 25.

Table 2. **Survival, height, DBH, and basal area per acre at age 26 and 25, by initial diameter class, for inside and outside rows separately and combined.**

	Root collar Diameter	1966 In	1966 Out	1966 Comb.	1967 In	1967 Out	1967 Comb.
Survival	2	22.5	32.5	29.2	26.2	32.5	28.3
	3	21.7	36.7	24.2	28.8	37.5	29.7
	4	22.6	43.3	25.2	28.7	38.3	29.7
	5	26.1	33.3	27.9	30.7	41.7	31.8
	6	26.8	39.0	29.4	28.9	37.5	30.3
	7	20.0	38.3	24.6			
	Means	23.3	37.2	26.8	28.7	37.5	30.0
Height	2	50.8	53.3	52.4	50.2	50.8	50.4
	3	52.0	55.7	52.6	49.0	48.8	49.0
	4	51.4	54.5	51.8	47.1	48.6	47.3
	5	49.9	52.2	50.4	47.6	55.5	48.4
	6	50.8	54.8	51.6	47.5	51.5	48.2
	7	48.4	53.2	49.6			
	Means	50.6	54.0	51.4	48.3	51.0	48.7
DBH	2	5.92	6.50	6.30	6.02	6.52	6.19
	3	5.58	7.51	5.90	5.50	5.50	5.50
	4	5.58	6.87	5.74	5.19	5.94	5.26
	5	5.24	6.57	5.58	5.29	7.53	5.52
	6	5.58	7.28	5.94	5.28	6.56	5.49
	7	5.22	6.83	5.62			
	Means	5.52	6.93	5.85	5.46	6.41	5.59
Basal Area	2	196.8	152.7	167.4	232.0	169.2	211.1
	3	174.1	225.5	182.6	224.6	144.2	215.6
	4	179.5	238.2	186.9	197.9	170.8	195.2
	5	180.0	174.0	178.5	214.7	259.7	219.2
	6	207.1	242.1	214.4	186.0	185.0	185.8
	7	147.5	215.4	164.5			
	Means	180.8	208.0	182.4	211.0	185.8	205.4

In addition to the problem presented by the 9-foot buffers between sub-blocks, the heavy mortality (70 to 75%) caused by the 3-foot spacing within sub-blocks raises a question about the validity or applicability of these results with respect to root collar

diameter. There are three factors, besides seedbed density, which affect initial root collar diameter:

1. Rate of germination is perhaps the most important factor. Seeds that are first to germinate tend to produce dominant or co-dominant seedlings in the seedbed, while the slowest seeds to germinate tend to produce intermediate and suppressed seedlings.

2. Seed size and weight affect seedling size, with the larger and heavier seeds tending to produce the larger seedlings by the end of the season.

3. Genetic differences in growth rate affect seedling size by the end of the growing season, and these may be the least important of the three when considering just the first season (in the seedbed).

These three factors are confounded, i.e., some inherently slow-growing seedlings undoubtedly originate from seed that germinates quickly or is larger or heavier than average, so that they are of larger than average diameter at the end of the first season. The reverse is also true; inherently fast-growing seedlings from slow-germinating or small seed may be of smaller than average diameter at the end of the first season.

The critical question is whether inherently slow-growing seedlings tend to be smaller in diameter at the end of the first season so that there are more inherently slow-growing seedlings represented in the smaller diameter classes. If so (and this seems reasonable), then the unusually heavy mortality resulting from the close-spacing used in this study may have favored the small diameter seedlings. If there was a higher proportion of inherently slow-growing seedlings among the small diameter classes, and if mortality eliminated most of the inherently slow-growing seedlings by age 26 or 25, then any long-term advantage of large-diameter seedlings would be reduced compared to a study planted at normal operational spacing, in which most trees would survive to age 25 or 26.[3]

Heavy mortality of inherently slow-growing trees might have reduced the differences between large and small seedlings that existed at age three, but it certainly wouldn't have caused the small seedlings to be the tallest (and also largest in DBH) at ages 26 and 25 (see Figure 2 and Table 2). An analysis of variance was performed on mean heights of all 96 seedling rows in each year. This involved pooling the four separate factorial studies for each year. This is not technically correct, but it is interesting that height differences among initial root collar diameter classes (2/32 to 7/32 in 1966 and 2/32 to 6/32 in 1967) were not statistically significant in either year (probability of a larger overall F=.15 in 1966

[3]See Occasional Report No. 107, *Loblolly Pine Seedling Grade--Effect On Survival and Growth Through 20 Years.*

and .25 in 1967). A similar analysis of variance was performed on mean DBH, and differences were not statistically significant in either year (probability of a larger overall F=.63 in 1966 and .16 in 1967).

In experiments 2, 3, and 4, which are the experiments that included seedlings with and without buds, seedlings with buds were by chance more often planted in outside rows in both years. In 1966, 10 of 16 outside rows happened to be seedlings with buds, and in 1967, 6 of 9 outside rows were seedlings with buds. In the 1966 study, at age 26, seedlings that set buds were .39 feet taller and .30 inches larger (in DBH) than seedlings that did not set buds. In the 1967 study, at age 25, seedlings that set buds were .90 feet taller and .23 inches larger. These differences can be at least partly explained by the differences in numbers of outside rows, that favored seedlings that set buds. Analyses of variance were performed, similar to the ones for initial root collar diameter, and none of the differences were statistically significant (probability of a larger F=.600 for height and .156 for DBH in 1966, and .251 for height and .200 for DBH in 1967).

The age 26 and 25 results of these studies surprised us. At age three, the size difference between small and large seedlings was striking, and we expected it to increase. We could not have imagined that the differences would disappear.

Appendix 1. Survival, mean height, mean DBH, and basal area per acre at age 26 for the 1966 study

Diam.	Treatment Lgth.	Bud	Survival Rep. 1	2	3	Means	Height Rep. 1	2	3	Means	DBH Rep. 1	2	3	Means	Basal Area Rep. 1	2	3	Means
2/32	4	no	40*	25*	45*	36.7	53.4*	51.2*	52.0*	52.2	6.12*	6.00*	7.11*	6.41	177.6*	111.2*	215.9*	168.2
2/32	6	no	30	20*	15	21.7	52.5	56.5*	49.0	52.7	5.83	6.75*	6.00	6.19	258.8	106.1*	134.8	166.6
3/32	4	no	25	25	25	25.0	53.4	52.8	51.8	52.7	6.40	5.80	6.20	6.13	255.3	206.8	237.5	233.2
3/32	6	no	15	35	30*	26.7	48.0	53.0	55.2*	52.1	4.67	6.00	7.67*	6.11	78.0	312.1	213.4*	201.2
3/32	6	no	25	15	45*	28.3	54.0	48.0	53.9*	52.0	5.40	4.67	7.00*	5.69	176.2	82.8	235.5*	164.8
3/32	6	yes	35*	10	15	20.0	57.9*	50.5	48.3	52.2	7.86*	4.00	5.33	5.73	227.5*	37.9	106.4	123.9
3/32	8	no	20	35	15	23.3	56.5	52.7	54.0	54.4	5.75	5.57	6.67	6.00	159.5	263.5	167.8	196.9
3/32	8	yes	20	20	25	21.7	55.8	53.2	48.0	52.3	6.50	6.00	4.80	5.77	205.7	177.3	144.1	175.7
4/32	6	no	20	25	15	20.0	55.8	53.0	52.3	53.7	6.00	5.60	6.33	5.98	177.3	203.3	143.0	174.5
4/32	6	yes	35	25	25	28.3	53.7	53.0	48.4	51.7	5.43	6.00	5.40	5.61	255.3	219.8	183.1	219.4
4/32	8	no	50*	35*	40	41.7	50.9*	55.0*	49.4	51.8	6.00*	6.29*	5.38	5.89	215.6*	160.0*	284.8	220.1
4/32	8	yes	25	45*	35	35.0	49.8	57.6*	54.7	54.0	5.20	8.33*	6.43	6.65	165.6	338.9*	346.3	283.6
4/32	6	no	25	10	15	16.7	52.4	50.0	53.0	51.8	5.60	4.50	7.00	5.70	196.1	48.5	202.2	148.9
4/32	6	yes	30	15	20	21.7	50.3	49.7	47.5	49.2	5.33	5.33	5.25	5.30	208.1	101.6	135.9	148.5
4/32	8	no	15	5	35	18.3	55.3	51.0	46.9	51.1	5.67	5.00	4.86	5.18	124.2	29.5	212.8	122.2
4/32	8	yes	20	25	15	20.0	53.0	53.6	46.3	51.0	6.25	6.20	4.33	5.59	192.7	261.2	79.1	177.7
5/32	6	no	20	10	30	20.0	47.8	53.0	49.7	50.2	4.25	6.00	5.33	5.19	86.3	87.6	217.6	130.5
5/32	6	yes	35	25	35*	31.7	50.4	50.2	52.9*	51.2	5.29	5.60	6.57*	5.82	247.1	191.6	178.2*	205.6
5/32	8	no	40*	40	25	35.0	52.0*	49.8	46.4	49.4	6.75*	5.25	4.40	5.47	223.6*	271.8	127.7	207.7
5/32	8	yes	25*	20	30	25.0	51.8*	51.2	50.2	51.1	6.40*	5.25	5.83	5.83	120.3*	138.3	251.8	170.1
6/32	6	no	25	25	20	23.3	50.2	49.4	47.2	48.9	5.60	4.40	4.75	4.92	193.8	116.0	107.5	139.1
6/32	6	yes	35	45	35	38.3	52.3	54.4	51.1	52.6	5.71	5.78	6.00	5.83	281.3	364.1	323.8	323.1
6/32	8	no	25	25	45*	31.7	52.0	51.4	51.8*	51.7	5.60	6.00	6.78*	6.13	198.5	217.6	249.0*	221.7
6/32	8	yes	30	35*	20	28.3	50.2	57.3*	47.5	51.7	5.33	7.86*	4.50	5.90	215.2	249.0*	96.9	187.0
6/32	8	no	25	15	20	20.0	49.0	49.3	56.0	51.4	5.80	5.00	7.00	5.93	206.8	88.6	241.2	178.9
6/32	8	yes	40*	35*	40*	38.3	53.5*	56.3*	54.9*	54.9	6.75*	8.00*	7.00*	7.25	220.1*	263.3*	229.2*	237.5
6/32	10	no	25	35	30	30.0	45.6	51.6	52.2	49.8	4.60	5.86	5.67	5.38	131.1	287.2	231.7	216.7
6/32	10	yes	20	40	15	25.0	50.0	50.1	55.0	51.7	5.50	5.00	8.00	6.17	146.5	243.6	243.6	211.2
7/32	8	no	35	30*	30	31.7	50.9	53.7*	46.2	50.3	5.43	6.67*	5.33	5.81	255.3	155.4*	212.8	207.8
7/32	8	yes	15	25	40*	26.7	53.0	49.8	54.4*	52.4	5.67	5.80	7.25*	6.24	114.7	216.3	245.1*	192.0
7/32	10	no	25	15	10	16.7	49.4	49.0	51.5	50.0	5.20	5.33	5.50	5.34	172.5	113.6	72.2	119.4
7/32	10	yes	45*	20	5	23.3	51.4*	52.2	34.0	45.9	6.56*	5.75	3.00	5.10	245.7*	159.5	10.6	138.6

***means an outside row adjacent to 9-foot buffer**

Appendix 2. Survival, mean height, mean DBH, and basal area per acre at age 25 for the 1967 study

Treatment			Survival Rep.				Height Rep.				DBH Rep.				Basal Area Rep.			
Diam.	Lgth.	Bud	1	2	3	Means	1	2	3	Means	1	2	3	Means	1	2	3	Means
2/32	4	no	25	30	35*	30.0	53.0	48.7	52.4*	51.4	6.00	6.00	6.71*	6.24	225.9	256.2	190.5*	224.2
2/32	6	no	30	30*	20	26.7	49.5	49.3*	49.5	49.4	5.33	6.33*	6.75	6.14	223.6	147.9*	222.5	198.0
3/32	4	no	25	45	30	33.3	51.2	47.9	51.3	50.1	5.60	5.44	6.17	5.74	212.0	322.7	287.6	274.1
3/32	6	no	40*	20	30	30.0	51.6*	45.2	50.7	49.2	6.00*	4.00	7.00	5.67	179.4*	137.5	358.7	225.2
3/32	6	yes	25	35	25	28.3	52.8	47.4	43.8	48.0	5.60	5.43	4.80	5.28	186.4	258.6	135.2	193.4
3/32	6	no	20	35*	25	26.7	52.0	46.1*	47.8	48.6	4.75	5.00*	5.80	5.18	105.9	108.9*	206.1	140.3
3/32	8	yes	35	20	30	28.3	52.7	46.2	41.7	46.9	5.71	5.75	4.67	5.38	281.9	157.2	167.6	202.2
3/32	8	no	25	25	45	31.7	55.8	50.6	46.7	51.0	6.60	5.40	5.33	5.78	269.1	176.0	330.8	258.6
4/32	6	yes	25	35	25	28.3	51.8	44.7	45.8	47.4	5.20	4.86	4.80	4.95	160.8	205.0	137.5	167.8
4/32	6	no	30	45	30*	35.0	55.2	44.2	44.3*	47.9	7.50	5.00	6.00*	6.17	441.4	308.6	150.2*	300.1
4/32	8	yes	25	40	40	35.0	56.2	44.1	48.0	49.4	6.40	4.75	5.50	5.55	253.9	221.2	291.3	255.5
4/32	8	no	40*	35	35	36.7	55.1*	46.1	47.9	49.7	6.38*	4.71	5.71	5.60	196.2*	187.5	279.5	221.1
4/32	6	yes	35	20	45*	33.3	51.0	42.8	46.3*	46.7	5.71	4.50	5.44*	5.22	281.9	107.2	165.9*	185.0
4/32	6	no	25	30	20	25.0	49.0	49.3	33.5	43.9	5.20	5.83	3.25	4.76	165.3	245.8	57.0	156.0
4/32	8	yes	20	30	25	25.0	47.6	48.0	43.0	46.3	4.50	5.67	5.00	5.06	95.5	228.3	148.0	157.3
4/32	8	no	20	35	25	26.7	50.5	43.3	49.4	47.7	5.25	4.71	5.60	5.19	131.5	192.2	190.9	171.5
4/32	10	yes	15	25	25	21.7	49.0	43.2	47.2	46.5	5.00	4.60	5.60	5.07	89.7	129.2	216.5	145.1
4/32	10	no	20	35	35	30.0	49.8	46.3	45.4	47.2	5.25	5.00	5.00	5.08	133.9	217.8	227.2	193.0
5/32	6	yes	45*	35	15	31.7	56.8*	39.7	48.7	48.4	7.33*	4.57	6.00	5.97	232.9*	193.3	128.1	184.8
5/32	6	no	38.5	30.8	38.5	35.9	49.4	49.5	47.2	48.7	5.20	5.50	5.40	5.37	264.4	231.0	296.2	263.9
5/32	8	yes	25	35*	35	31.7	53.2	56.9*	46.3	52.1	6.40	8.71*	5.14	6.75	251.5	311.6*	223.6	262.2
5/32	8	no	35	20	40	31.7	50.7	37.0	46.9	44.9	5.43	3.25	5.00	4.56	256.2	57.0	251.5	188.2
5/32	10	yes	30	35	30	31.7	50.2	46.4	49.3	48.6	5.33	5.14	5.67	5.38	207.3	223.6	226.3	219.7
5/32	10	no	25	50	35	36.7	55.0	38.1	46.6	46.6	6.80	4.50	5.71	5.67	277.2	294.7	279.5	283.8
5/32	8	yes	30	45*	25	33.3	50.5	52.7*	48.0	50.4	5.50	6.56*	5.00	5.69	217.8	234.7*	150.3	200.9
5/32	8	no	25	35	35	31.7	46.2	48.4	48.1	47.6	5.20	5.71	5.71	5.54	172.3	272.5	274.8	239.9
5/32	10	yes	30	20	40	30.0	49.8	49.2	45.1	48.0	5.33	5.00	5.00	5.11	223.6	118.7	253.9	198.7
5/32	10	no	20	25	25	23.3	49.8	49.2	46.0	48.3	5.00	5.80	4.60	5.13	121.1	201.6	127.1	149.9
6/32	8	yes	40*	38.9	15	31.3	53.9*	49.0	49.7	50.9	7.12*	4.86	6.67	6.22	245.1*	200.3	165.3	203.6
6/32	8	no	33.3	11.1	23.5	22.6	50.3	50.5	47.8	49.5	5.67	5.50	5.50	5.56	228.3	75.8	142.0	148.7
6/32	10	yes	35	45	35*	38.3	46.9	49.4	49.1*	48.5	5.57	5.44	6.00*	5.67	276.1	322.7	124.9*	241.2
6/32	10	no	15	30	42.1	29.0	45.7	43.7	42.2	43.9	5.00	3.83	4.75	4.53	96.7	113.0	240.0	149.9

***means an outside row adjacent to a 9-foot buffer**